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Some Considerations in Concrete Road Design

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Bureau of Engineering
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More research effort has been devoted to the design of concrete highways for motor traffic than to any other type of road and these researches have resulted very successfully in the improvement of the concrete pavement, both from a structural and from an economic standpoint. Not only is the present-day concrete pavement stronger where strength is most needed but this increased strength has been effected by a redistribution of materials rather than by a general increase in thickness. The researches which have thus far been conducted have resulted in a theory for concrete pavement design which is based on a few simple facts or at least on what seem to be facts when viewed in the light of our present knowledge.

A large number of the state highway departments have accepted a design in which the edges are thicker than the center of the pavement, a design which has resulted from extensive researches undertaken during the past several years.

The general theory upon which this so widely accepted cross-section is based is very elementary and is premised on the following ideas:

1. Traffic operates over the entire pavement area and, therefore, the pavement must be capable of supporting heavy wheel loads wherever applied.
2. It is particularly undesirable that the pavement be cracked into slabs of very small areas, for rapid failure and high maintenance expense will ensue.
3. Since a corner crack produces a small area of slab this is an undesirable condition and should be prevented.
4. The structural strength of the concrete alone can be relied upon for supporting a load applied at the corner of the slab, and subgrade support, for design purposes, should be neglected.

5. Concrete suffers fatigue very rapidly when the bending stress in tension exceeds half of the modulus of rupture of the concrete.

As has been pointed out in a number of technical papers the above premises have led to a design formula for determining the thickness at the edge of the slab. In the development of this formula it is assumed that the worst loading condition is that in which the rear wheel of the heaviest truck permissible is placed at the corner formed by the intersection of an expansion joint with the side of the pavement. It is further assumed that in view of the possibility of the occurrence of soft subgrade conditions, that no subgrade support can be relied upon under the load, which then is entirely supported by virtue of the structural strength of the road slab. The rear wheel therefore is held up by what is known in mechanics as a beam of uniform strength and without discussing the details of the derivation of the formula the edge thickness is calculated as follows:

$$D = \sqrt{\frac{3P}{S}}$$

Where
D = edge thickness of pavement
P = maximum wheel load
S = allowable unit stress in tension which should not exceed half of the modulus of rupture of concrete.

When a center longitudinal joint is used, such as a tongue and groove joint, which is capable of transferring load from one side of the joint to the other, it is assumed that two corners act to support a wheel load placed on one side of the center joint instead of only one corner as in the case of a wheel placed at the extreme edge of the slab. Again, without entering into detail, there results a formula which expresses the thickness of the cen-

ter of the pavement in terms of the edge thickness. This formula is as follows:

$$d = \frac{7}{10} D$$

Where d = center thickness of pavement
 D = edge thickness of pavement

It is to be noted particularly that the pavement thickness at the edge and center calculated in the foregoing manner are based entirely on the necessity for preventing small slabs from forming, for should the corners of the pavement break off, the small slabs thus resulting would soon be pounded down into the subgrade and rapid disintegration of the pavement would ensue due to the impact of traffic. The above formulas form the basis for the cross-section design of concrete roads used in the majority of the states, notwithstanding the fact that many of the states probably have drawn up their cross-sections without thought of the fundamental principles governing their design.

Stress investigations have shown that the highest bending stress always occurs under a wheel load when that load is placed at the edge of the pavement slab and when it is considered that not only is high tension produced in concrete due to wheel loads but also by shrinkage and by atmospheric changes, it can readily be understood why it is so important that concrete for pavements must, above all else, have high tensile resistance.

Concrete, like other structural materials, suffers from fatigue when it is repeatedly stressed and such fatigue tests as have been made show that if a bending stress is produced which is in excess of one-half of the so-called modulus of rupture of the concrete only a few applications of such a stress can be made before failure occurs. On the other hand, if the bending stress produced by loads is less than half of the modulus of rupture, thousands of applications can be repeated with no apparent effect. The repeated load tests upon which this statement is based have been made on dry concrete and it is possible that quite different results would be obtained with wet concrete; in fact, some tests indicate that fatigue effects are far more severe on wet concrete than on dry concrete and, therefore, cracking due to bending is much more likely to take place when concrete is wet than when it is dry. To overcome this difficulty a lower unit stress had probably better be used in concrete subjected to wet conditions. This is equivalent to saying that a thicker pavement under those conditions seems desirable.

Transverse Cracks

Many transverse cracks in concrete pavements are undoubtedly due to direct tension which is produced when the slab shrinks due to the drying out of moisture or to a decrease in temperature. When shrinkage takes place the pavement moves over the subgrade and meets with frictional resistance between the subgrade and the slab, tending to prevent this motion. It is this frictional re-

sistance which produces direct tensile stress in the concrete and during the periods of expansion of the concrete due to moisture and rising temperature, direct compression might also be produced, but with properly spaced expansion joints the direct compression is kept within safe limits. This cannot be said of direct tension or cross-bending stress however, as evidenced by the frequent transverse cracks which take place.

In a plain concrete road it is unquestionably of very great importance that the concrete have high tensile resistance and high resistance to cross bending. High compressive strength is important only insofar as this quality indicates high strength in bending and in direct tension. Concretes, having high compressive strength may vary considerably in their resistance to cross bending and it is of considerably more importance in making tests of concrete for concrete roads that the cross-breaking test be made rather than the compression test, for a cross-breaking test furnishes a true index of the particular quality of concrete necessary for successful concrete roads. This is a point which is overlooked by many state highway departments. Concrete roads do not fail by direct compression but they do fail by direct tension and cross bending. Cross-bending resistance is likewise a kind of measure of tensile resistance so that a cross-breaking test, which can be performed very simply in the field with inexpensive apparatus, is the test which should be made on concrete for concrete pavements.

Opening of Road Controlled by Cross-Bending Test Made in the Field

There is no doubt that many concrete pavements have been cracked excessively during the early stages of their hardening because traffic loads have been allowed on the pavement before a sufficient resistance to cross-breaking has developed. Such cracks become visible at a later period. By the use of transverse test specimens made on the work with concrete used on the job and cured under the same conditions as the pavement, it is entirely practicable to determine just when it is safe to open the pavement to traffic. It might be thought that having once established a safe period for curing the same period might be used for all jobs, but this would be a very unsafe assumption for all concrete does not gain strength at the same rate. A number of variables always are present which influence the rate of gain in strength including cement characteristics, water content, temperature, humidity, character of aggregate and no doubt others.

The safe procedure is to make tests for cross-bending and on the basis of these tests and of the loads to be carried determine when to throw the road open to traffic. As an illustration of this method the following example is given:

Let the road be 9 inches thick at the sides and 6 inches at the center. Such a road has been designed in antici-

pation of receiving a wheel load determined as follows:

$$D = \sqrt{\frac{3P}{S}} \quad (\text{see page 1})$$

or

$$P = \frac{D^2 S}{3}$$

Let the assumed safe unit stress "S" be 300 lbs. per sq. in.

$$P = \frac{D^2 S}{3} = \frac{9 \times 9 \times 300}{3} = 8100 \text{ lbs.} = \text{safe}$$

maximum wheel load for a 9-6-9 in. pavement.

It is unwise to permit any traffic on the pavement during the early period of its hardening which will have any possibility of cracking it at the corners formed by expansion joints or by transverse cracks. Although the pavement may have been designed to ultimately accommodate a given maximum wheel load, in this case 8100 lbs., it is quite possible that the location of the road is such that the maximum weight of vehicle will not be carried for a few years to come. It is thus permissible in a number of cases to open the road to traffic before it has attained the strength requisite for the maximum load for which it was designed. To determine when to open the road to traffic which will use it immediately, the procedure is to make concrete beams with the concrete used in construction and store these beams on the work, cured under road curing conditions and then at regular intervals break the beams to determine their cross-breaking strength. From the strengths obtained it can be determined whether the road can safely carry the loads. The following is an illustration of what might be a typical case:

Beams have been made up and cross-breaking tests are started at an early period and run at regular intervals with the following results calculated in terms of modulus of rupture:

Age	Modulus of Rupture
6 days	250
9 "	360
12 "	450
15 "	500
18 "	550
21 "	570

It is known that vehicles with 6,000 pound wheel loads will seek this particular stretch of road as soon as

it is opened. The stress produced by such vehicles will be:

$$S = \frac{3P}{D^2} = \frac{3 \times 6000}{9' \times 9'} = 222 \text{ lbs. per sq. in.}$$

To be safe we had better not allow this vehicle to run, which is equivalent to saying we had better not open the road, until the concrete has attained a modulus of rupture about double the unit stress produced. In the above case the road may be opened when the concrete has attained a modulus of rupture of 444 lbs. The actual tests show that 450 lbs. was attained at the end of 12 days and at that period the road might be safely opened to traffic. If desirable lighter traffic might even be permitted before this time depending on the cross-breaking strength of the concrete as determined by tests.

If during the curing period the heavy loads will not be repeated frequently, a higher unit stress might be permissible up to 2/3 of the modulus of rupture indicated by the beam tests. In the above case, under this assumption, it would be safe to permit the 6,000 pound wheel load when the concrete had attained a modulus of rupture of 333 lbs. per sq. in.

The following table shows safe wheel loads depending on the modulus of rupture of the concrete determined by beam tests:

Modulus of Rupture	Unit Stress	Edge Thickness			
		7 in.	8 in.	9 in.	10 in.
200	1/2 of	1630	2130	2700	3330
300		2450	3200	4050	5000
400	Modulus	3270	4270	5400	6670
500	of	4080	5330	6750	8330
600	Rupture	4900	6400	8100	10000
700		5720	7470	9450	11700
800		6530	8530	10800	13300
200	2/3 of	2180	2840	3600	4430
300		3270	4270	5400	6670
400	Modulus	4370	5700	7200	8900
500	of	5450	7110	9000	11100
600	Rupture	6530	8530	10800	13300

The cross-breaking test is not only extremely simple to make in the field but is seen to serve a most useful purpose. Its intelligent use will greatly decrease future maintenance expense and increase the life of the concrete road.

TENTH ANNUAL CONVENTION, NATIONAL CRUSHED STONE ASSOCIATION

Book-Cadillac Hotel, January 17, 18, 19 and 20, 1927

All Crushed Stone Producers throughout the U. S. and Canada whether or not members of this Association are most cordially invited to attend this Convention

The President's Page

W. R. Sanborn Represents N. C. S. A. at Meeting of Executive Board of Associated General Contractors

In the September issue of the Journal we referred to our having been invited to meet in Kansas City with the Executive Board of the Associated General Contractors of America to consider the winter storage of stone on the roadside and at the job. A sudden and unavoidable conflict of duties prevented our attending; but Vice President Sanborn of the Northern Region kindly consented, at a moment's notice, to represent us at the meeting and to endeavor to further develop the suggestion we had previously made—that a joint committee of the Associated General Contractors and of this Association be formed, with representatives from the Portland Cement Association, the Asphalt Association, the American Roadbuilders' Association, and the Department of Commerce. He discussed with his usual thoroughness and intelligent analysis this problem, affecting, as it does, state highway departments, contractors, aggregate producers, and manufacturers of equipment used in construction. A part of his report of this meeting, interesting as it is to all crushed stone producers, follows:

"Touched very briefly on Desirability of Winter Quarry Operation, that increased winter construction requires quarries to operate all winter, or store for winter during the summer peak load. Why accent the summer peak? Why not partly fill the winter sag? That quarry operators would welcome some way of increasing the season from the average of 8 or 9 months to 10 or 11 months. Then the Possibility of Winter Quarry Operation. Favorable factors being easy labor, reduced overhead greater output for the plant investment, and that as stone is screened rather than washed, cold weather is no handicap. Unfavorable factors being that quarries need some weeks in winter for annual overhauling; that snow is not easy to crush if it's soft; but that the only real adverse factor is inability to market the product without the cooperation of the contractor.

"Lastly, the Problems Involved in Winter Storage. Difficulty of producer being able to foresee the sizes that he should store at the plant, due to the great variation in specifications, makes plant storage difficult. Contractors not being set up at destination makes it difficult to store on the job. Some expense at either end. If State does not give an estimate for material, then the problem of producer carrying the stone and contractor the freight. Pointed out that stock pile on the job must be kept clean, which means a big pile. Discussion followed—pointed out that in Illinois big cone is forbidden as sizes separate. That state departments must be enlisted as well as producers and contractors.

"Colorado contractor stated they already had all we dreamed about: standard sizes of stone; 1927 contracts

let this October, stone stored all winter, Missouri Highway Department buys material all the year, takes delivery and pays cash.

"I am glad the N. C. S. A. was represented."

So are we and by so able a representative, to whom we offer our grateful appreciation of his work.

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National Officers to Make Extended Tour

Elsewhere in the pages of this issue will be found a list of the meetings throughout the West, Pacific Coast, Southwest and Southeast which the officers of the Association, pursuant to the request of the Board of Directors and the approval of the Executive Committee, expect to attend. So extended a tour, requiring somewhat over a month to complete, entails a sacrifice of time and expenditure of funds, which was determined upon only after a most thoughtful study of the potential advantages of developing personal contact with the producers in these sections of the country. We believe that our Association will soon be in a position to afford aid and assistance in the vexatious problems which confront us all to producers throughout the United States, however remote they may be from our Washington office.

The fundamental purpose of this trip is to test the soundness of this theory and if it be found reasonable and good, to secure greater membership support in the more distant sections of the country than we now enjoy.

We are grateful to the men sponsoring the various meetings, some of whom are at present not members of the Association, but who are none the less willing to give generously of their time to the success of these gatherings. Each one of them is inviting producers, whether or not members of the Association, throughout the territory tributary to his particular meeting to attend. The Vice President for each Region is extending invitations to all producers in his territory to attend one or more of the meetings held in that Region. The Washington office and the President's office are each sending out invitations to all producers throughout the Western and Southern sections of the country to attend these meetings and some two thousand invitations are going forward from each of these offices.

We are all requesting the associate members, through their local representatives, to call to the attention of producers throughout the territories involved the value of attending these meetings.

In these ways we hope to acquaint every producer in

the sections in which meetings are held, with our desire to have him present. If by any chance this article should be read by anyone who has not received a personal invitation, we trust that he will pardon the unintentional error and will accept the invitation which we most cordially here and now extend to meet with us at any one of the meetings most convenient to him.

* * * * *

Manufacturers' Division, Committee on Welfare and Safety and Executive Committee Hold Meetings in New York

Four years ago this month, the first dinner of the Manufacturers' Division was held in a small room of the Hotel Commodore in New York, with ten members present, an attendance which we regarded at that time as most gratifying. On the 15th of the present month their fifth annual dinner was held with Chairman Garber presiding at the Commodore with over fifty enjoying the delightful dinner arranged by Mr. Gordon Buchanan. The members of the Executive Committee, the Treasurer of the Association, and Mr. Adams and Mr. Bowles of the Bureau of Mines were guests. The strong undercurrent of enthusiastic optimism for the success of our various association activities was both reassuring and encouraging. We have no more loyal members than those comprising the Manufacturers' Division, responsive as they always have been and are now to the needs of the Association, catching as they do the spirit underlying our endeavors and permeating the Association itself.

They are planning by far the largest and most interesting exposition we have yet enjoyed at one of our annual conventions and it will be well worth while for every member company to see that its superintendents and operating men are present in Detroit, if for no other reason than to share in the program and practical discussions planned for their benefit and to discuss with the manufacturers methods of operation and changes in equipment and material bearing thereon.

On the same day the Executive Committee held a luncheon meeting with every member present (except Mr. Doolittle, who is suffering from a broken ankle), a fact which in itself is indicative of the loyalty and interest in our welfare of those men to whom the association has delegated, in conjunction with the Board of Directors, the supervision of its policies and activities.

In the afternoon Chairman Greensfelder called together the newly formed Committee on Welfare and Safety

for its first meeting. The Bureau of Mines evidenced its interest in our efforts in this direction by sending to confer with the committee Mr. Adams and Mr. Bowles. In due course the committee will disclose definite plans and procedure, the following of which it is believed will be of benefit to the entire industry. We are indebted to the members of this committee for undertaking so arduous a task, yet withal one the consummation of which should be of material value to all of us.

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Work on Detroit Convention Progresses

The program for the Detroit convention is beginning to round into final form. We are securing speakers of authority on their chosen subjects covering a wide range of interests. We will have with us highway engineers and executives, railroad officials, engineers of constructions, lawyers, bankers and business men from within and without our industry. We believe that no more interesting, instructive or entertaining program has ever been arranged for one of our annual conventions than that which we will enjoy at Detroit.

There will be novel features of entertainment, including, we hope, a full half day spent in the Ford automobile factory.

The program of daily group luncheons which we have followed in the past will be modified to a very considerable extent, the rearrangement being, we believe, even more pleasurable and interesting.

There is every reason to assume that all attendance records will be broken at Detroit. It is a delightful city, centrally located, splendid hotel facilities, with every opportunity placed at our disposal to make this convention more successful, enjoyable and worth while than any we have ever held, and no stronger commendation than this could be voiced. Attendance at this convention is a duty resting upon every producer of crushed stone, only because of the opportunity it affords him to share in the progress the industry is making, to become acquainted not only with his competitors, but with those engaged in his occupation from other sections of the country, to discuss with others the problems affecting all of us, to enjoy the especially fine addresses which will be offered, and to discuss with manufacturers the improvement in quarry equipment and supplies.

Every crushed stone producer throughout the United States and Canada, whether or not a member of the Association, is cordially invited to be with us in Detroit and to share in our pleasure and advancement.

Schedule of Meetings to be held in Connection with Transcontinental Trip of N. C. S. A. Officials

There is given below the schedule of meetings to be held in connection with the transcontinental trip of the Officers of the National Crushed Stone Association, details of which are given on the President's Page.

Madison, Wisconsin, Meeting..... Monday, November 8th	1:00 P. M.—Hotel Loraine..... (luncheon meeting)	Mr. A. J. Blair, Lake Shore Stone Co., Milwaukee, Wis.
St. Paul, Minnesota, Meeting..... Tuesday, November 9th	1:00 P. M.—Minnesota Club..... (luncheon meeting)	Mr. John Wunder, Broadway and K Streets, Minneapolis, Minn.
Omaha, Nebraska, Meeting..... Wednesday, November 10th	9:00 A. M.—Hotel Fontenelle.....	Mr. Thos. Sullivan, 1042 Omaha National Bank Building, Omaha, Neb.
Cheyenne, Wyoming, Meeting..... Thursday, November 11th	10:00 A. M.—Chamber of Commerce.....	Mr. C. J. Cunningham, S. Cunningham & Son, Horse Creek, Wyoming.
Denver, Colorado, Meeting..... Thursday, November 11th		Mr. James Lawrence, Golden Basalt Products Co., Golden, Colo.
Salt Lake City, Utah, Meeting..... Saturday, November 13th	3:00 P. M.—Chamber of Commerce.....	Mr. Eric Ryberg, P. O. Box 1214, Salt Lake City, Utah.
Portland, Oregon, Meeting..... Thursday, November 18th		Mr. Daniel Kern, 294 E. Salmon Street, Portland, Oregon.
San Francisco, California, Meeting..... Monday, November 22nd	10:00 A. M.—Palace Hotel.....	Mr. A. R. Wilson, Granite Rock Company, Watsonville, Calif.
Los Angeles, California, Meeting..... Probably Tuesday or Wednesday, November 23rd or 24th		Mr. Geo. A. Rogers, 1403 E. 16th Street, Los Angeles, Calif.
El Paso, Texas, Meeting..... Monday, November 29th	10:00 A. M.—Hotel Orndorff.....	Mr. A. Courchene, El Paso Limestone Quarry, El Paso, Texas.
San Antonio, Texas, Meeting..... Tuesday, November 30th	10:00 A. M.—Hotel Gunter.....	Mr. R. J. Hank, 310 Littlefield Building, Austin, Texas.
New Orleans, Louisiana, Meeting..... Thursday, December 2nd	10:00 A. M.—Hotel St. Charles.....	Mr. I. L. Lyons, Jr., Southern Mineral Company, New Orleans, La.
Atlanta, Georgia, Meeting..... Friday, December 3rd	1:00 P. M.—Atlanta-Biltmore Hotel.....	Mr. Thos. McCroskey, Box 292, Knoxville, Tenn.
Nashville, Tennessee, Meeting..... Saturday, December 4th	10:00 A. M.—Andrew Jackson Hotel.....	Mr. A. B. Rodes, 610 12th Avenue N., Nashville, Tenn.

The offices of the President and Secretary are each mailing out some 2,000 invitations to crushed stone producers, state and county highway officials, and other interested parties, located in the territories of the respec-

tive meetings, cordially and earnestly inviting them to be present at the meetings shown above. In addition to this the different men in charge of the meetings are making every effort to reach all of the producers in their respective territories. Although every endeavor is being made to reach all crushed stone producers in the regions of these meetings, nevertheless owing to the extreme difficulty of obtaining complete and accurate lists it is not at all improbable that some producers have been overlooked. It would indeed be unfortunate if some who desired to attend these meetings were denied this opportunity due to not having received an invitation or because they were unaware of the fact that these meetings are to take place. To such of you as may read these columns we here and now most cordially invite

you to be present at the meetings which you find most convenient. You will be received with the same hearty welcome as is accorded those who attend in response to personal invitations.

It will be noted that in some instances it has not been possible as yet to give full and complete information relative to the time and place of some of the meetings. By the time this Journal is in your hands this can undoubtedly be obtained from those in charge whose addresses are shown below.

This is going to be a great trip and will mean much to the crushed stone producers as well as to the Association and we are certainly looking forward with pleasure to meeting you boys from the wide open spaces and the sunny southland.

Local Association Activities

New York State Crushed Stone Association

Forty-three members and guests, the largest turnout in the past three years, were present at LeRoy, N. Y., at the October 1st meeting, which convened at the quarry of the LeRoy Lime & Crushed Stone Corporation at 10:30 o'clock A. M.

"Len" Heimlich, as Chief Host of the Day, cordially and properly greeted the arrivals as they came in, and about an hour was passed in renewing acquaintanceship, after which the plant and quarry were subjected to group inspection until about noon. You have seen and heard of this model plant before, so it will be unnecessary to record any detailed explanation.

Just after twelve, we motored down to the General Crushed Stone Company's North LeRoy quarry where another half hour elapsed in an inspection tour under the guidance of Superintendent Scott. Here again we must necessarily dispense with detail as it would be but a repetition of last year's meeting.

However, comment was overheard at both operations regarding their size and cleanly condition, and both Messrs. Heimlich and Scott are to be commended in this respect. As a matter of record, the present aggregate production at the two quarries is in the neighborhood of 6,000 tons daily.

At 1 P. M. sharp, the bell rang and everyone hastened down the lane to the new celebrated Hunting Lodge of Len Heimlich. Here, under the leadership of an imported chef, ably assisted by Bill Anderson, Al Hooker and W. R. Heimlich, a repast had been prepared that will long be remembered by all present. After group pictures by Edmund Shaw of Rock Products, Chicago, President Seitz and the inimitable Jim Savage with his movie camera, the assemblage was seated at a long table erected in the grove.

Our guests of the occasion included National Secretary

Boyd of Washington, Editor Shaw of Chicago and Highway Department Division Engineers Smith, Dempster and Waters of Rochester, Hornell and Buffalo, respectively.

Rapping for order, President Seitz called upon Ex-National President John Rice, who stated that one of our members who had always enjoyed our gatherings, was not with us today. After sorrowfully eulogizing our departed associate and friend, Mr. Rice asked that we stand for a moment in silence, in respect to the memory of Frederick W. Schmidt.

Then, the dinner, which was a contribution to the Association by the joint hosts of the day, the LeRoy Lime & Crushed Stone Corporation and the General Crushed Stone Company.

Following the meal, President Seitz called a business meeting to order. The minutes of the August 27th meeting at Gouverneur and Alexandria Bay, submitted by the Secretary, were approved by vote.

After some discussion on the question of standardized sizes which had been made a special order for this meeting, it was decided to postpone further consideration until the November meeting.

National Secretary Boyd was then called upon, and in a short address, explained some of his work at National headquarters at Washington and stressed the importance of cooperation with local associations and individual producers. We know Mr. Boyd thoroughly enjoyed his visit with us and assure him the pleasure was entirely mutual. We hope he will come again.

Secretary Schaefer then moved that a suitable resolution of condolence at the loss of our departed member, Frederick Schmidt, be spread upon the records of this Association and a copy of same transmitted to Mr. Schmidt's widow at Millington, N. J. Seconded by Mr.

McGrew and unanimously carried.

Division Engineers Smith, Dempster and Waters were then called upon in turn and each responded briefly stating his satisfaction at being present.

It was then moved, seconded and carried that the next meeting be held at Buffalo on November 11th.

Following the adjournment resolution, informal discussions and other diversions took up the balance of the afternoon, the gathering disbanding at 5 P. M.

Respectfully submitted,

GEORGE E. SCHAEFER,
Secretary.

SOUTHWESTERN DIVISION

The Southwestern Division of the National Crushed Stone Association held its first meeting, since its organization, at the Hotel Austin, Austin, Texas, on Tuesday, September 21, with eight of the members present.

President Wise opened the meeting and gave special emphasis to the importance of the members making their plans to attend the Detroit meeting.

He also called attention to Mr. Graves' suggestion that when Divisional meetings are held, sufficient notice be given Mr. Boyd, Secretary of the N. C. S. A., in order that members of the Manufacturers' Division might be present. It is the sense of the meeting that this should be done.

Only two stone producers in Oklahoma have become members of the Southwestern Division, but President Wise stated he felt sure the other producers would join and as soon as possible he hoped to make a personal appeal to them.

Mr. Hank, Secretary-Manager, outlined the work he had been doing and what was proposed in the way of sending out literature and keeping the members advised as to his activities and new work coming up. He also reported on his recent trip to Atlantic City to attend the meeting of the Board of Directors of the N. C. S. A. as well as his conference with Mr. Goldbeck at Washington.

The meeting was then thrown open to discussion for all members. It was the unanimous opinion of all present that these meetings should be held regularly, at least every three months.

THE OHIO CRUSHED STONE ASSOCIATION

The regular monthly meeting of the Governing Board of the Ohio Crushed Stone Association was held in the offices of the Association in Columbus, October 14th, 1926. President E. E. Evans presiding.

Minutes of the September meeting were read and approved without correction.

There being no unfinished business to transact, Presi-

dent Evans immediately entered into the special order of business for the day.

Mr. O. W. Merrell, Division Engineer of Division No. 10 of the Ohio Highway Department, was present to discuss with us the subject "How to Obtain Better Cooperation between the Stone Producers and the Highway Engineer—from the Engineer's Standpoint." Before introducing Mr. Merrell, President Evans made some preliminary remarks in which he suggested that in behalf of our association Director Schlesinger should be thanked for his cooperation in permitting Mr. Merrell to be with us and your Engineer was directed to express to Mr. Schlesinger our appreciation.

Following Mr. Merrell's introduction we enjoyed an hour and a half of very informal discussion in which Mr. Merrell brought out two particular points or we might say that he made two definite recommendations.

First—that a survey of the entire crushed stone industry in Ohio should be made by our Association in the report of which should be listed the names of all the operating companies, the approximate amounts of each of the various sizes of stone they will be able to produce in a year as well as the grade of stone produced from their various quarries. Exceptions were taken to this latter point, however, because it was felt that since the Highway Department has been making tests from all these quarries through a period of years that the average of these tests would perhaps serve as more accurate guide than any particular sample that might be taken for the purpose as suggested by Mr. Merrell. This point was conceded by Mr. Merrell.

His second recommendation was to the effect that the producers should furnish the class of material desired by the Highway Department; that it should be graded according to specifications and that it should be delivered, or at least billed from the quarry, when promised. He explained that not all of his troubles were with the stone producers and that it is a common practice among the producers of all kinds of material to accept an order for shipment on a certain date when they know it is impossible to ship on that date. The engineers are often inconvenienced by this practice in that they make all arrangements for the unloading and distribution of these materials and they will not be delivered until several days after they are promised.

He also stressed the necessity of shipping good clean material and explained that they had often been asked to accept an inferior grade of stone. This practice on the part of the producer only tends to cause the loss of the engineer's confidence in this company and the industry in general. In other words, he advised the "laying of the cards on the table—face up." In short, if you cannot deliver the exact size and grade that the engineer wants, when he wants it, be honest with him, tell him so, tell

him when you can deliver and 99 per cent of the times you will receive his order anyway.

The question of one or two major changes and several minor changes in the specifications were discussed as well as the adoption of a new cross-section design for macadam pavements and Mr. Merrell expressed a willingness to cooperate with us in these matters before the 1927 specifications were finished.

Other questions of interest to the association were discussed and the meeting in general was considered of much benefit.

On motion of Mr. Yearwood and seconded by Mr. Drummond, we adjourned.

Respectfully submitted,

CARL L. VAN VOORHIS,
Chief Engineer.

Manufacturer's Division Holds Annual Pre-Convention Dinner Meeting

The Manufacturers' Division of the National Crushed Stone Association held their annual pre-convention dinner meeting on Friday, October 15, at the Commodore Hotel, New York City.

The meeting was undoubtedly one of the most successful and best attended ever held in the history of the organization, there being over fifty present, including as guests Oliver Bowles, from the Non-Metallic Station of the United States Bureau of Mines, located at New Brunswick, New Jersey; W. W. Adams, from the Statistical Division of the United States Bureau of Mines located at Washington, D. C., and the following officers and members of the Board of Directors of the National Association: O. M. Graves, W. Scott Eames, F. R. Kanengeiser, John Rice, E. J. Krause, A. T. Goldbeck, James Savage, F. W. Schmidt, Jr., John Rice, Jr., W. L. Spörborg, J. R. Boyd. Following is a full list of those in attendance:

M. B. Garber, Sanderson-Cyclone Drill Co., Orrville, O.
Otho M. Graves, Pres., Nat'l Crushed Stone Ass'n, Easton, Pennsylvania.

W. Scott Eames, New Haven Trap Rock Co., New Haven, Conn.

Gordon Buchanan, C. G. Buchanan Co., New York City.

L. W. Shugg, General Electric Co., Schenectady, N. Y.

S. R. Russel, E. I. DuPont De Nemours and Co., Wilmington, Dela.

J. B. Crew, Marion Steam Shovel Co., Marion, O.

Arthur F. King, Marion Steam Shovel Co., Marion, O.

Wm. Blade, American Manganese Steel Co., Chicago Heights, Ill.

A. E. Halcomb, Koehring Co., Milwaukee, Wis.

W. O. Weil, W. S. Tyler Co., Cleveland, O.

Albert S. Reed, W. S. Tyler Co., Cleveland, O.

Chas. W. Price, Cement, Mill & Quarry, N. Y. C.

P. K. Armstrong, Ingersoll-Rand Co., N. Y. C.

J. W. Moreton, Ingersoll-Rand Co., N. Y. C.

T. E. Fisher, Allis-Chalmers Mfg. Co., Milwaukee, Wis.

J. K. Brandon, Ensign-Bickford Co., Simsbury, Conn.

W. M. Annette, Hercules Powder Co., Wilmington, Dela.

R. Grubb, Canadian Explosives, Ltd., Montreal, Canada.

F. R. Kanengeiser, Bessemer Limestone & Cement Co., Pittsburgh, Pa.

Oliver Bowles, U. S. Bureau of Mines, New Brunswick, N. J.

W. W. Adams, U. S. Bureau of Mines, Washington, D. C.

N. S. Greensfelder, Hercules Powder Co., Wilmington, Dela.

S. E. Cole, Pit and Quarry, Chicago, Ill.

E. G. Lewis, Bucyrus Co., N. Y. C.

G. W. Flounders, C. G. Buchanan Co., N. Y. C.

L. D. Hudson, Symons Bros. Co., Milwaukee, Wis.

John Rice, General Crushed Stone Co., Easton, Pa.

E. J. Krause, Columbia Quarry Co., St. Louis, Mo.

E. H. Paull, Ingersoll-Rand Co., N. Y. C.

R. C. Sullivan, Rock Products, N. Y. C.

D. C. Souder, France Stone Co., Toledo, O.

Willard Young, Atlas Powder Co., Wilmington, Dela.

A. T. Goldbeck, National Crushed Stone Ass'n, Washington, D. C.

B. F. Damon, Cement, Mill and Quarry, New York City.

B. G. Dann, Hendrick Mfg. Co., Carbondale, Pa.

S. F. Macpeak, Earle C. Bacon, Inc., New York City.

James Savage, Buffalo Crushed Stone Co., Buffalo, N. Y.

F. W. Schmidt, Jr., Morris County Crushed Stone Co., Morristown, N. J.

Fred A. Gill, Gill Rock Drill Co., Lebanon, Pa.

R. A. Wholley, Blaw-Knox Co., Pittsburgh, Pa.

Thos. Robins, Jr., Robins Conveying Belt Co., New York City.

John Rice, Jr., General Crushed Stone Co., Easton, Pa.

J. C. Farrell, Easton Car & Const. Co., Easton, Pa.

H. M. Davison, The Hayward Co., New York City.

Judson Hayward, The Hayward Co., New York City.
 C. B. Andrews, Taylor-Wharton Iron & Steel Co., High Bridge, N. J.
 J. C. Houston, Browning Crane Co., Cleveland, O.
 John C. Taylor, Taylor-Wharton Iron & Steel Co., High Bridge, N. J.
 W. L. Sporborg, Rock-Cut Stone Co., Syracuse, N. Y.

The meeting got under way shortly after six o'clock when Chairman Garber rapped for order, which was the cue to begin serving a most appetizing dinner. Chairman Garber certainly chose wisely in placing Mr. Gordon Buchanan in charge of arrangements as the dinner was par excellence.

Immediately after the termination of the dinner, O. M. Graves, President of the National Association, was called upon for a few words. President Graves sketched briefly the history of the Manufacturers' Division, pointing out its phenomenal growth from its first meeting five years ago, with about ten present, to the present meeting, with over fifty in attendance, and emphasized the spirit of helpfulness and cooperation which has always marked the relations between the active and associate members of this Association. He spoke of one who was always eager to make unstinting sacrifice of his time and energy in the interests of the Association and who we deeply regret is no longer with us. In silent tribute to the late F. W. Schmidt, the entire meeting stood with bowed heads for a moment.

President Graves also discussed plans which were being made for the Detroit Convention and pointed out that excellent facilities were provided by the Book-Cadillac Hotel, it being possible to confine all of the activities of the convention, including the Manufacturers' Division Exhibition, to one floor.

President Graves was followed by short addresses from Mr. Goldbeck, Director of the Bureau of Engineering of the National Association; Mr. Bowles and Mr. Adams of the United States Bureau of Mines; and Messrs. Rice, Krause, Eames, Savage, Sporborg and F. W. Schmidt, Jr.

The meeting expressed its regret at the inability of Messrs. N. C. Rockwood and W. E. Farrell to attend and instructed the Secretary to so inform them by wire.

Chairman Garber then called upon the only representative present from Canada, Mr. R. Grubb of the Canadian Explosives, Ltd., who expressed his pleasure at being able to attend.

Mr. Greensfelder, Chairman of the newly appointed Committee on Welfare and Safety, was then called upon and briefly outlined the plans of his committee.

Mr. Boyd, Secretary of the National Association, discussed the details of the Detroit Convention with particular reference to the Manufacturers' Division Exhibition. He stated that full particulars relative to the exhibit would shortly be mailed to all associate members and closed his remarks with an urgent appeal for all members to act promptly, as soon as they were in receipt of the application blanks for booth space.

The remainder of the evening was devoted to perfecting plans for the Manufacturers' Division Exhibition at the annual convention of the Association in Detroit on January 17, 18, 19 and 20, 1927, after which the meeting adjourned.

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EXECUTIVE COMMITTEE MEETS IN NEW YORK

The Executive Committee of the National Crushed Stone Association held its regular pre-convention meeting in New York City at the Commodore Hotel, on Friday, October 15.

The following members of the Executive Committee and guests were present: O. M. Graves, H. E. Bair, J. R. Boyd, W. Scott Eames, A. T. Goldbeck, F. R. Kanengeiser, E. J. Krause, John Rice and W. L. Sporborg.

The meeting was largely devoted to a discussion of the plans for the Detroit Convention which are rapidly being perfected and give promise of producing the most successful convention in the history of the Association.

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COMMITTEE ON WELFARE AND SAFETY HOLDS FIRST MEETING

At the call of Chairman Greensfelder the newly organized Committee on Welfare and Safety of the National Crushed Stone Association, held its first meeting at the Commodore Hotel, New York City, on Friday, October 15, at 4 P. M.

The following members of the committee were present: N. S. Greensfelder, W. W. Adams, cooperating member from the U. S. Bureau of Mines; J. F. Heimlich, D. C. Souder, John Rice, Jr., and J. R. Boyd. There were also in attendance Oliver Bowles, from the U. S. Bureau of Mines; O. M. Graves, President of the National Association; A. T. Goldbeck, Director of the Bureau of Engineering of the National Association, and John Rice, member of the Board of Directors of the National Association.

The meeting was called for the purpose of planning a campaign of action for promoting Welfare and Safety in the crushed stone industry.

After briefly outlining the proposed work of the committee Chairman Greensfelder called upon W. W. Adams of the Statistical Division of the U. S. Bureau of Mines in Washington, who offered the fullest possible cooperation of the Bureau of Mines in furthering this most important work.

Oliver Bowles, of the non-metallic station of the U. S. Bureau of Mines at New Brunswick, New Jersey, was then called upon and gave the committee many valuable suggestions.

D. C. Souder also gave the committee the benefit of his experiences in safety work with the France Stone Company.

After pro and con discussion the meeting adjourned with the feeling that excellent progress had been made and that very definite recommendations could be made on this subject to the Detroit Convention in January.

The CRUSHED STONE JOURNAL

J. R. BOYD, Editor

A. T. GOLDBECK, Director, Bureau of Engineering

The National Crushed Stone Association

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PRESIDENT GRAVES APPOINTS NEW COMMITTEE ON WELFARE AND SAFETY

Following is the personnel of the newly appointed Committee on Welfare and Safety. President Graves, in inviting the various members to serve, wrote as follows:

"We have long realized that as an association we should more actively participate in the effective work being done by several organizations to increase the welfare and safety of employees. Individually, as producers, we recognize the humanity involved in reducing avoidable accidents to a minimum; and we are also aware that such a policy is an economic saving as well. Our lack of activity in this direction has been due not so much to a failure to realize the importance of this work, but rather because no tangible means has presented itself to enable our efforts to be made effective and serviceable to our various members. Mr. Evans has become nationally known in safety work and is, as you know, the chairman of the Quarry Section of the National Safety Council. Mr. Greensfelder has perhaps done more than any other one man to bring to the attention of the non-metallic industry the importance of a well developed safety program.

"Mr. Greensfelder has consented to act as the chairman of a newly created committee on Welfare and Safety, and the personnel of the committee is such as to assure the Association that definite, reasonable and helpful recommendations will be made by the committee to the Detroit convention."

N. S. Greensfelder, Chairman, Hercules Powder Co., Wilmington, Del.

E. E. Evans, Whitehouse Stone Co., Spitzer Bldg., Toledo, O.

D. C. Souder, France Stone Co., Toledo, O.

L. R. Cartwright, Mid-West Crushed Stone Co., Indianapolis, Ind.

John Rice, Jr., General Crushed Stone Co., Drake Bldg., Easton, Pa.

W. R. Casparis, Casparis Stone Co., Clinton Bldg., Columbus, O.

J. L. Heimlich, LeRoy Lime & Stone Corp., LeRoy, N. Y.

Harry Landa, Landa Rock Products Co., New Braunfels, Texas.

W. W. Adams (cooperating member from U. S. Bureau of Mines).

W. D. Keefer (cooperating member from National Safety Council).

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COMMITTEE ON RESEARCH IS APPOINTED

President Graves has recently appointed the following Committee on Research and in asking the various members to serve, commented as follows:

"For some time it has been our desire and intention to appoint a committee on research whose general function would be not only to act as a clearing house to consider problems and needs of various sections of the country, but also to originate lines of investigation and research of interest and potential benefit to the industry. Such a committee can also effectively serve as an advisory council to our Bureau of Engineering. The members of this committee have been selected with particular care, having due regard not only to geographic location, but to their particular qualifications as being interested in the scientific aspects of our work, and most of them are engineers of reputation."

F. C. McKee, Chairman; West Penn Cement Co., Oliver Bldg., Pittsburgh, Pa.

A. T. Goldbeck, Dir., Bureau of Engineering, N. C. S. A., Earle Bldg., Washington, D. C.

C. L. VanVoorhis, Ohio Crushed Stone Ass'n, Hartman Bldg., Columbus, O.

H. M. Sharp, France Stone Co., 1800 2nd Nat'l Bank Bldg., Toledo, O.

R. J. Hank, Southwestern Division, N. C. S. A., Littlefield Bldg., Austin, Texas.

Prevost Hubbard, Asphalt Ass'n, 441 Lexington Ave., New York City.

C. A. Munson, New Haven Trap Rock Co., 67 Church St., New Haven, Conn.

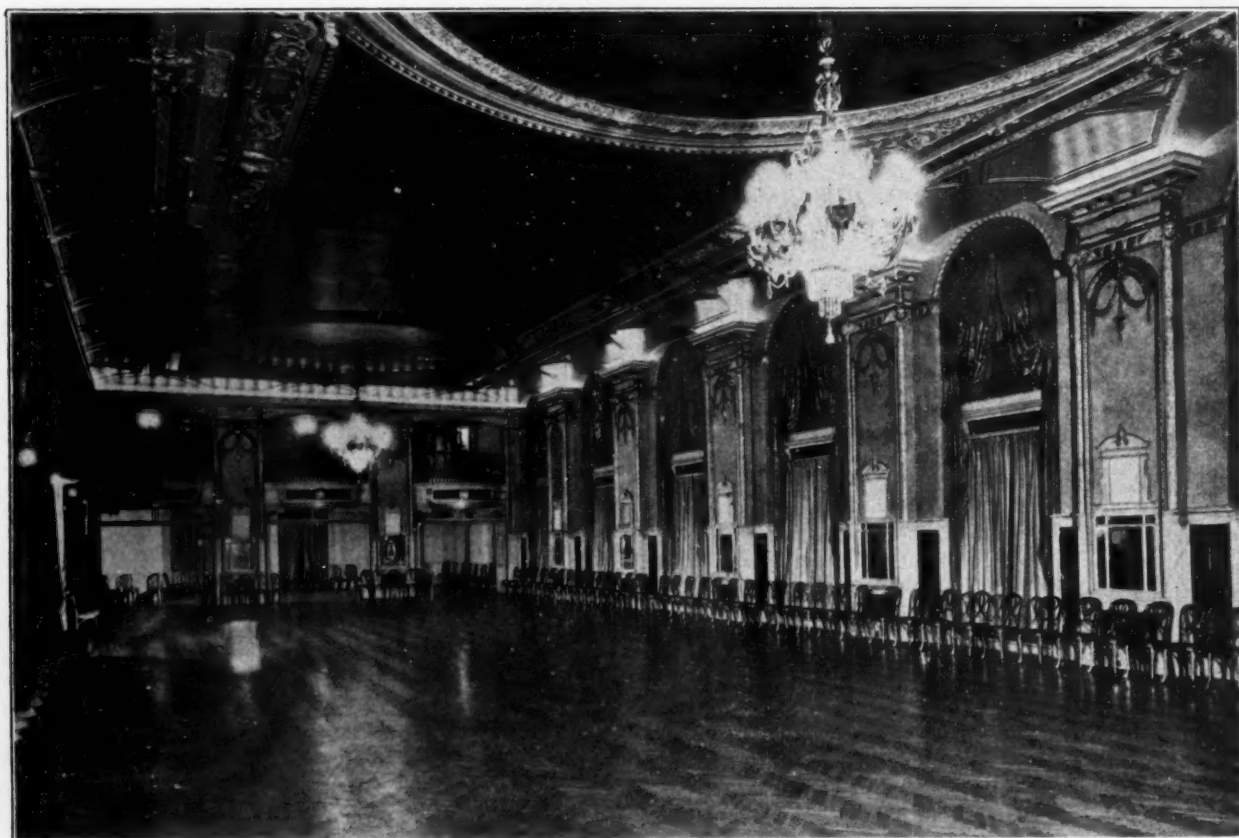
W. R. Sanborn, Lehigh Stone Co., Kankakee, Illinois.
Thos. McCroskey, American Limestone Co., Knoxville, Tenn.

J. W. Stull, Liberty Lime & Stone Co., Rocky Point, Va.

Geo. E. Martin, The Barrett Co., 40 Rector St., New York City.

Superintendents and Operating Men!

Be sure to attend our Tenth Annual Convention and Exhibition of Quarry Equipment and Machinery, Book-Cadillac Hotel, Detroit, Michigan, January 17, 18, 19 and 20, 1927



One entire Session will be devoted to you

An inspection of the Manufacturers' Division Exhibition alone will
more than repay you for the trip

National Crushed Stone Association

651 Earle Building

Washington, D. C.

